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T E C H N I C A L R E P O R T

Evaluating Water Temperature, Habitat and Fish Communities in Candidate Coolwater Streams in Illinois

Annual Project Report 2007

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Dr. David Thomas,
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PROJECT TITLE: Evaluating Water Temperature, Habitat, and Fish Communities in Candidate Coolwater Streams in Illinois.

Summary:

Work during this reporting period focused on characterizing temperature, habitat, and biological communities at candidate sites. During the past year we have collected additional temperature data from candidate streams and other locations and now have records from 112 stream reaches. Twenty three sites have been identified as cool- or coldwater based on these records. Physical habitat surveys were conducted at 33 sites where temperature data were available. Fish and macroinvertebrate data were obtained from the cooperative basin survey program data managers for candidate sites whenever possible. These data were supplemented with fish and macroinvertebrate samples from 8 sites where temperature records suggest coolwater thermal regimes and other data were unavailable. This report summaries progress for the period beginning 30 September 2006 and ending 29 September 2007.

JOB 1. Review list of candidate coolwater streams and identify a subset of streams for validation.

Approximately 200 potential sampling sites were selected using the original candidate list, state-wide summer temperature models, and additional information to: (1) directly measure candidate site temperatures, (2) evaluate the temperature model, and (3) to supplement existing temperature records throughout the state (Figure 1). With input from Illinois Department of Natural Resources (IDNR) Fisheries Division stream specialists in each of the five management regions we identified a subset of these sites for temperature monitoring and other sampling for the 2007 field season (Figure 2). We will continue to monitor sites selected from these efforts in 2008.

JOB 2. Characterize the thermal regime, habitat (e.g., channel morphology), and vegetation in each stream identified in Job 1.

Fifty-eight electronic temperature recorders were deployed by INHS staff to assess thermal regimes in candidate coolwater streams segments during the summer of 2007. Another thirty-eight temperature loggers were supplied to IDNR stream specialists for deployment at additional sites (Figure 2). High summer water levels in northern Illinois prevented logger placement at some sites until very late in the season. We have recovered information from 57 of these sites at this time (several loggers were lost). A total of 120 temperature records from 112 sites have been collected statewide that cover a broad range of thermal conditions (Figure 3). We plan to continue monitoring temperature at 50+ sites during 2008.

We used available temperature records to categorize sites as coldwater (mean <19 ^{o}C [66 ^{o}F]), coolwater (19 ^{o}C > mean <22 ^{o}C), or warmwater (mean >22 ^{o}C [72 ^{o}F]) and then summarized daily temperatures for each group into weekly means. Mean weekly summer temperatures appear to differ between these groups for Illinois streams (Figure 4). We plan to use these data summaries as a rapid assessment tool for distinguishing thermal regimes of candidate sites from

point estimates of temperature during the 2008 field season. Our approach will be similar to that used to classify sites for the development of the Indiana coolwater index of biotic integrity (ARC 2007).

In stream physical habitat surveys were conducted at 33 sites where temperature records were available. Preliminary analysis suggests that coolwater sites are characterized by higher summer current velocities and greater channel complexity (as indicated by a greater number of channel units within the sample reaches) than warmwater streams.

JOB 3. Determine availability and applicability of other data to predict additional coolwater streams.

Stream segments throughout Illinois were given a thermal code based on the Minimum and Maximum July water temperatures from a predictive model developed using GIS derived catchment summaries. Cold/cool-water segments made up approximately 16% of the total number of coded segments state-wide (Figure 2).

We also reviewed information from the scientific and conservation literature (e.g., Pickering 1950, Ruddy 1999) as well as data from statewide monitoring programs (IDNR/IEPA cooperative basin surveys, Critical Trends Assessment Program) to locate potential coolwater sites. Point locations associated with this review were compared with the candidate list and our initial summer stream temperature model output. Locations with overlap between these data sources were prioritized for field surveys and temperature logger placement. Sites with historical records of candidate coolwater fish species that were not included in the initial candidate listing were also prioritized. Study sites were selected to evaluate the full range of the model output and the biological data including the initial coolwater candidate streams. A total of 204 sites were selected for potential evaluation during this study.

JOB 4. Characterize a subset of streams identified in Job 3.

More than 60 sites were visited during the 2007 field season including many of those identified in Job 3. Initial evaluation of the temperature model using field based temperatures indicates that the model does an excellent job predicting warm water sites (92% accuracy) but is less accurate at predicting coolwater stream segments (42% correctly identified). With the acquisition of additional temperature data this multiple linear regression model should be refined to more accurately identify coolwater streams in Illinois.

A subset of the sites with field based temperature records are being used to examine inter-annual temperature variation. Sixteen sites with previous records were again monitored with temperature loggers during the summer of 2007. These data suggest that while interannual variation occurs most of these sites maintain the same thermal class (i.e., cold, cool, or warm) when using temperature records from different years.

Four stream networks were examined for spatial and longitudinal extent of thermal conditions by monitoring temperature in adjacent and neighboring stream segments. These records suggest

that the thermal regime within a stream network can be a complex mosaic of cool and warm waters related to the interconnectedness of the stream channels and the differential effects of instream cover and ground water inputs (Figure 5).

JOB 5. Conduct macroinvertebrate sampling at a subset of sites.

In addition to obtaining records from IEPA cooperative basin survey macroinvertebrate collections we sampled at 8 sites where preliminary analysis suggested that the streams had coolwater thermal regimes. We are also planning to sample macroinvertebrates using methods similar to those employed by the CTAP professional scientist with the goal of obtaining compatible samples focusing on EPT taxa (Ephemeroptera, Plecoptera, Trichoptera) during the spring of 2008 at locations with observed coolwater temperatures.

JOB 6. Compile and analyze data and write a report.

No work was scheduled for this Job. Preliminary data were developed into a poster that was presented at the 2nd Annual Driftless Area Symposium sponsored by the Driftless Area Initiative in Decorah, Iowa.

LITERATURE CITED:

Aquatic Research Center of the Indiana Biological Survey. 2007. Development of Coolwater Index of Biotic Integrity Expectations for Use in Streams and Rivers of Indiana and Review of Existing Data. Technical Report 2007-01. Indiana Biological Survey, Aquatic Research Center, Bloomington IN.

Pickering, Q. H. 1950. Distribution of the fishes of the smaller streams of northwestern Illinois. Master's thesis, University of Illinois. 172 pages.

Rudey, R. 1999. Northern Illinois Stream Study: A preliminary assessment of the potential of selected northern Illinois streams to support a self-sustaining trout population. The Illinois Council of Trout Unlimited, Highland Park, IL. 43 pages, 2 appendices.

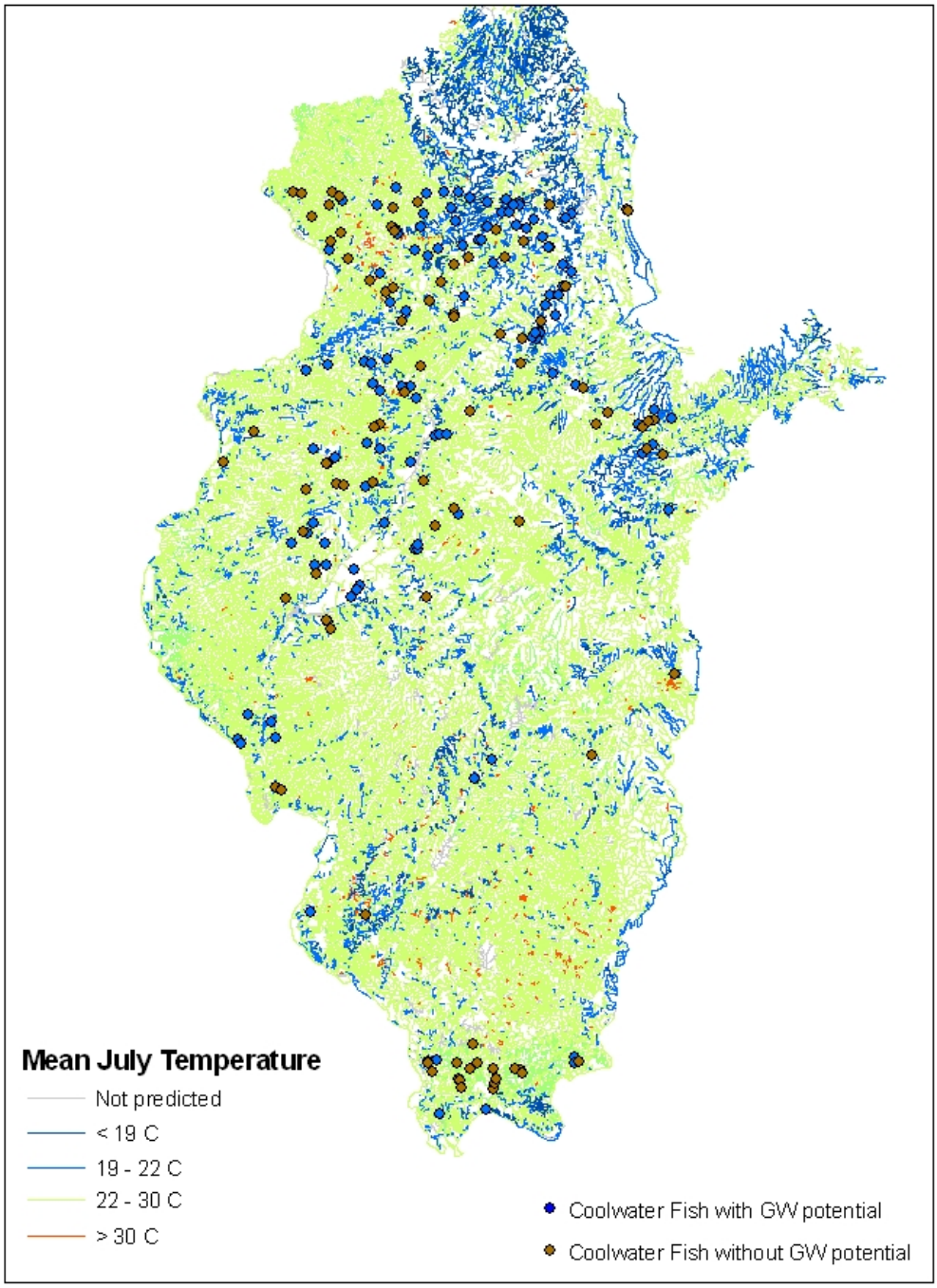

Figure 1. Candidate Coolwater sites and Summer Stream Temperatures based on model output.

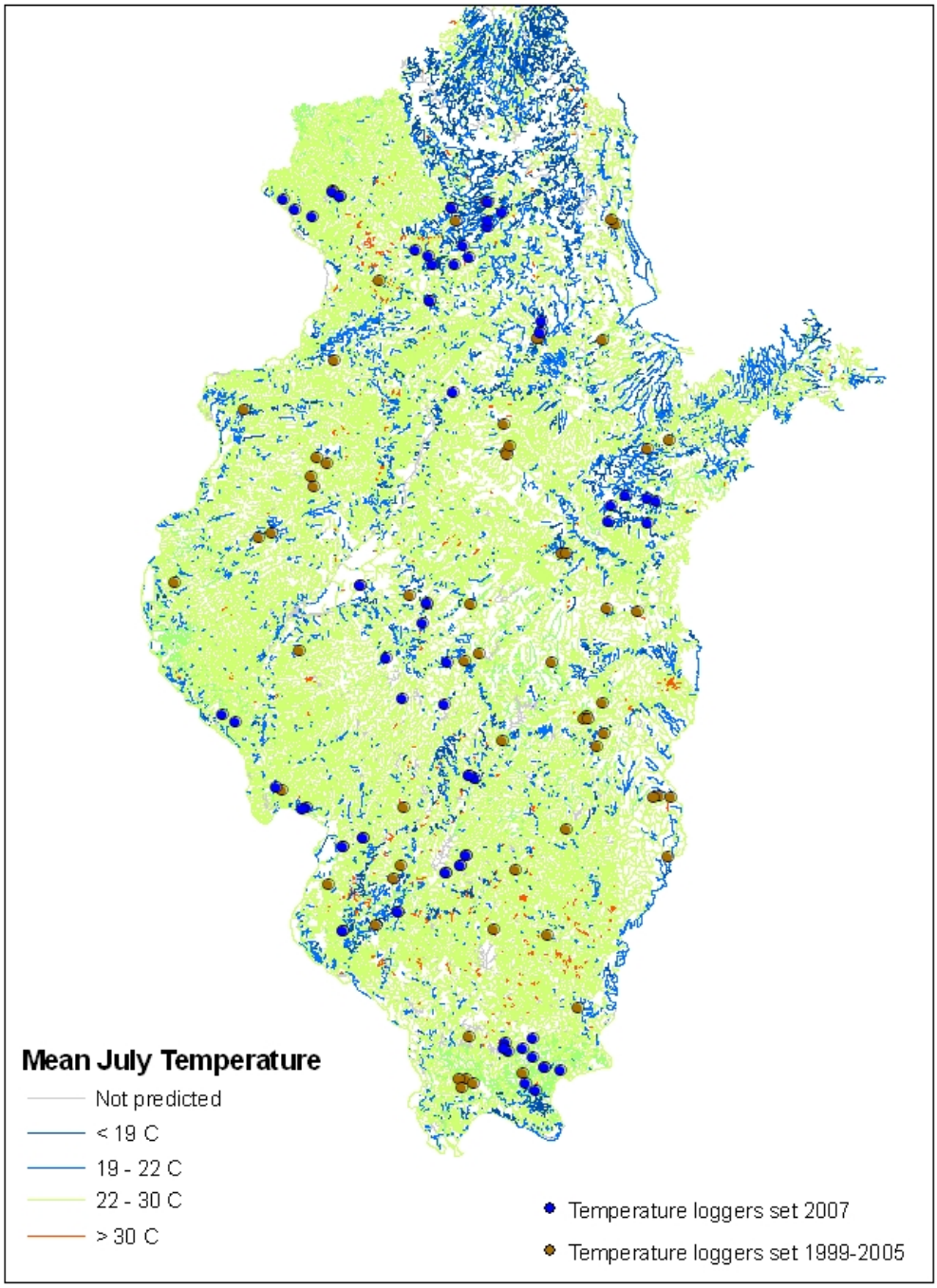

Figure 2. Temperature logger locations and Summer Stream Temperatures based on model output.

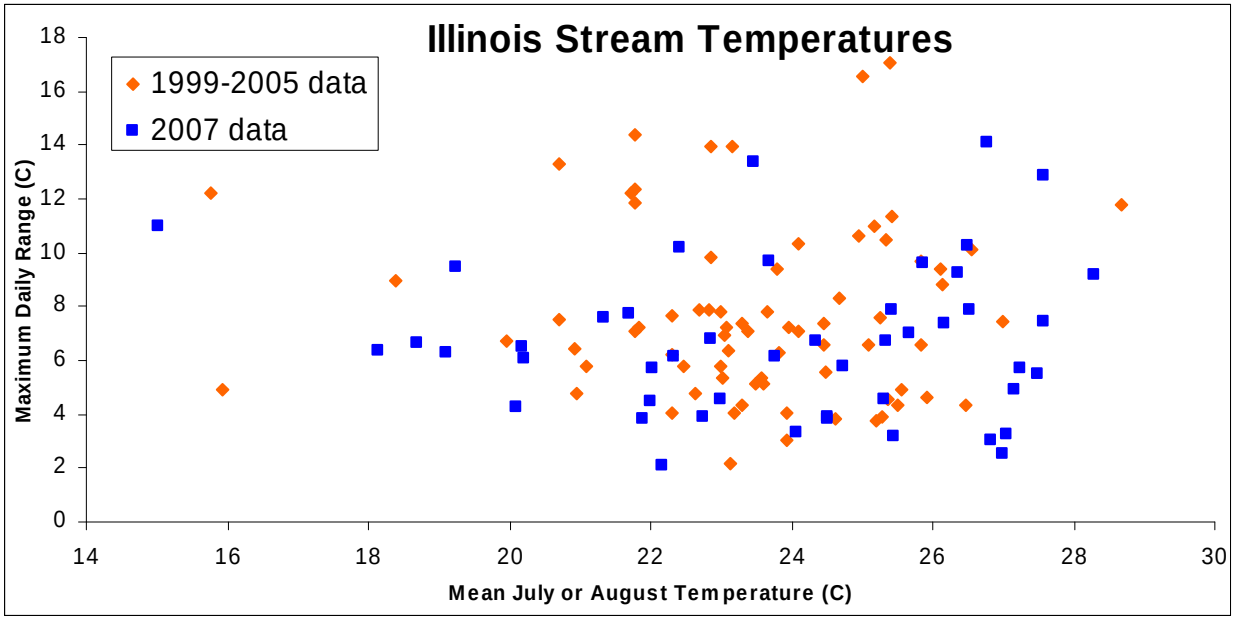

Figure 3. Mean summer stream temperatures from Illinois. Coolwater streams are those that have mean July/August temperatures below 22 ^{o}C.

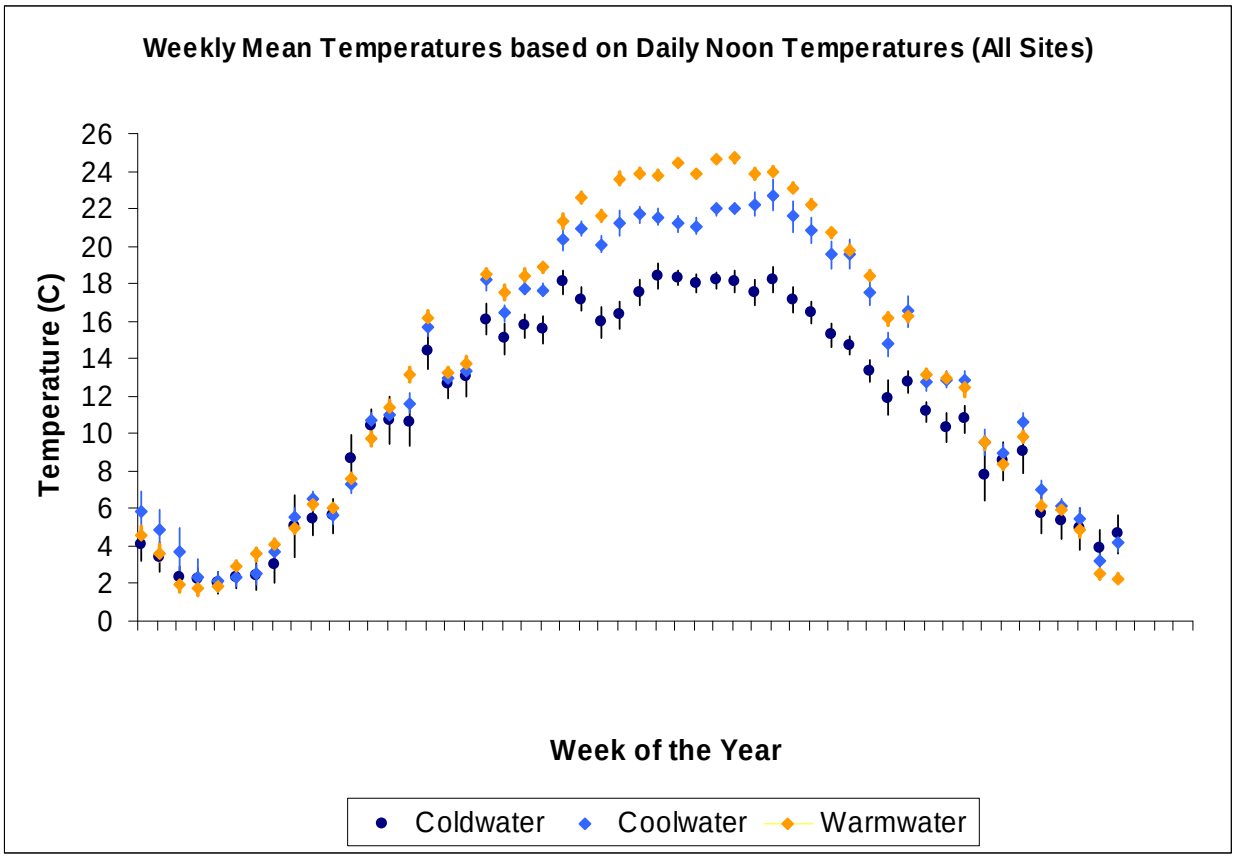

Figure 4. Distribution of weekly mean temperatures for streams with characteristic cold, cool, and warm summer temperatures based on approach used by the Indiana Biological Survey in the development of coolwater index of biotic integrity (ARC 2007).

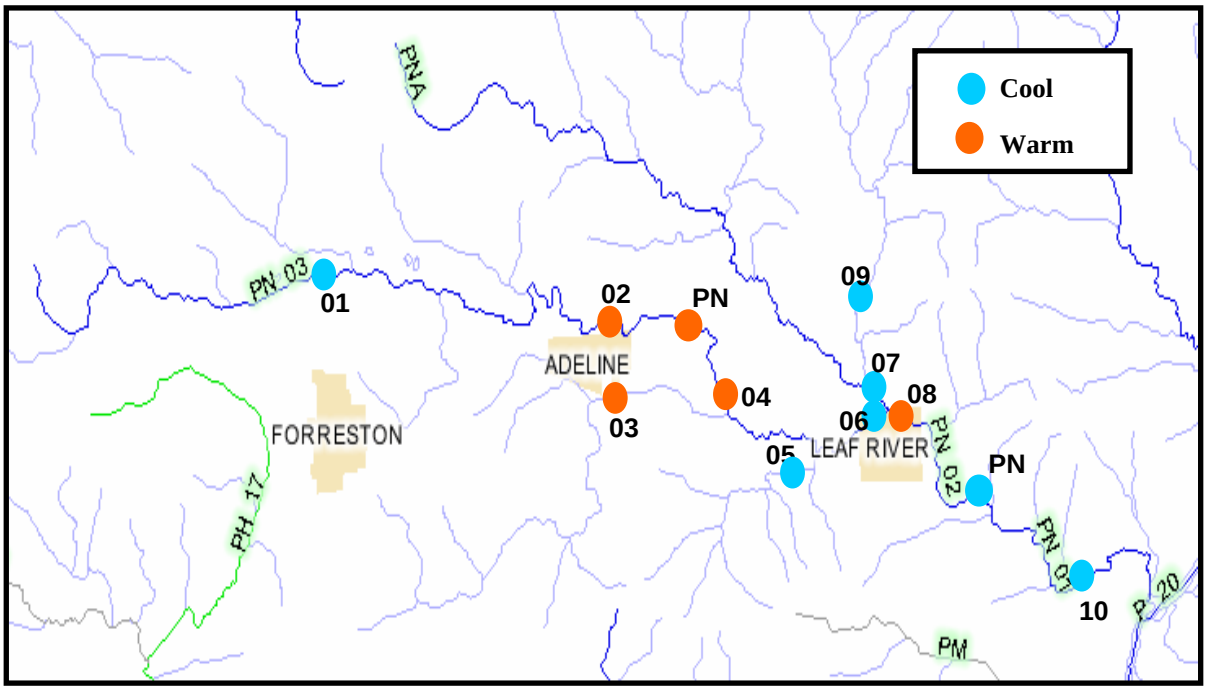

Figure 5. Leaf River (Ogle County, IL) thermal pattern based on network sampling 1-14 August 2007. Coolwater sites had mean daily temperatures less than 22 ^{o}C during the sampling interval, warmwater sites had mean daily temperatures of greater than 22 ^{o}C. Notice how the stream is warmest in the middle reaches (near Adeline) and is cooler in some of the headwaters and the downstream reaches.